



Design & Flight Testing of a Mortar Deployed Video Imager

4/10/01, NDIA PRES.

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Design & Flight Testing of a Mortar Deployed Video Imager

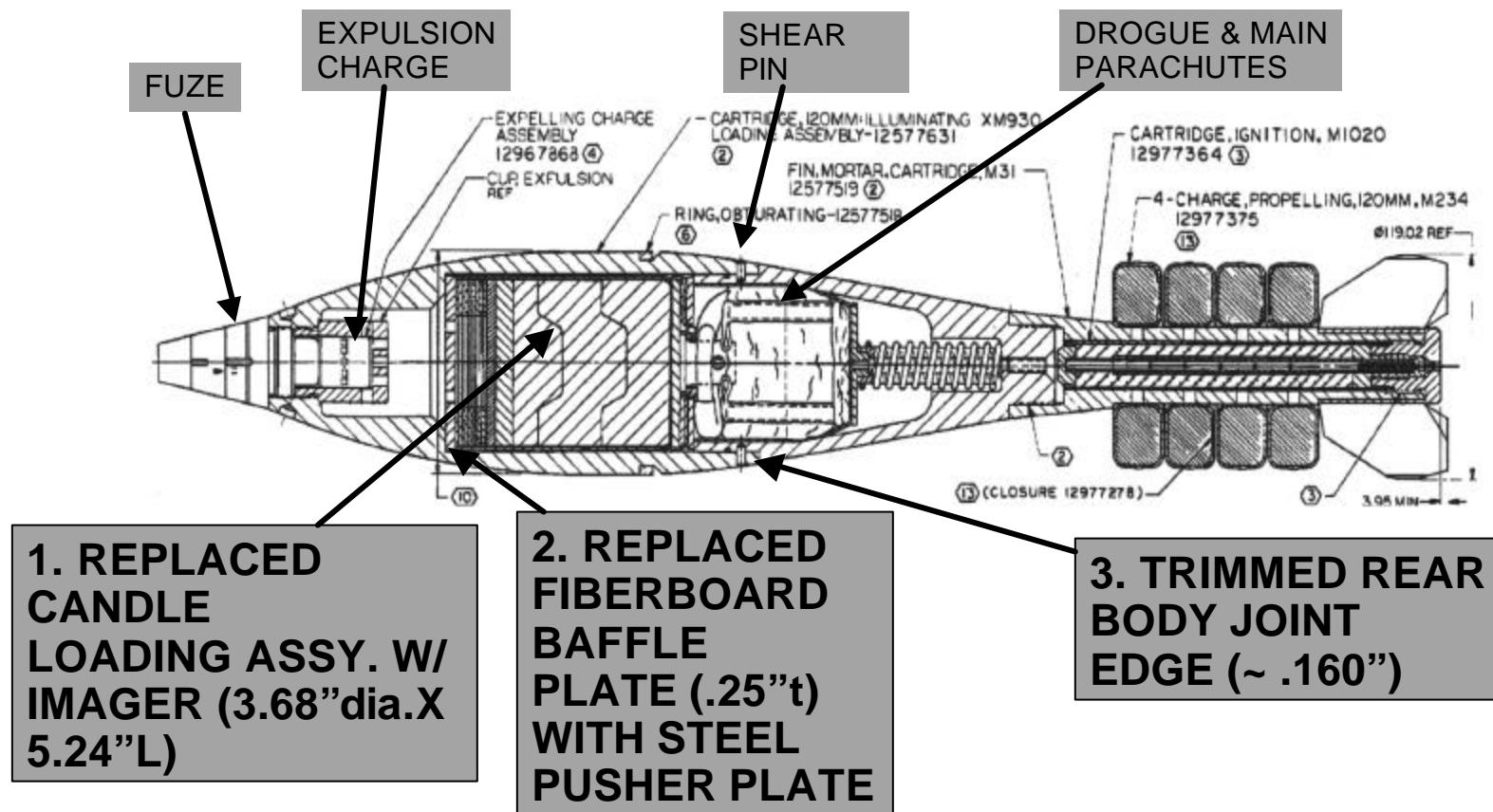
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- **OBJECTIVES:** DESIGN & DEMONSTRATE A GUN-HARDENED, “WIRELESS”, DIGITALLY-ENCRYPTABLE, IMAGER SYSTEM (<\$10k/imager)
- **SUPPORTS:** ARDEC QUICKLOOK STO.
- **PLAN:** APPLY COTS VIDEO AND XMTR TECHNOLOGIES & INTEGRATE INTO A MODIFIED XM930 120mm MORTAR SUBMUNITION.
- **CONCLUSIONS:** SUCCESSFULLY FLIGHT-TESTED IMAGER MORTAR TO ~2000 G'S, PCZ #1.
- **LESSONS LEARNED:** IMAGERY MUST BE ANALYZED TO DETERMINE USAGE, TLE, BDA, etc. & TO DETERMINE REQ'D. IMPROVEMENTS.

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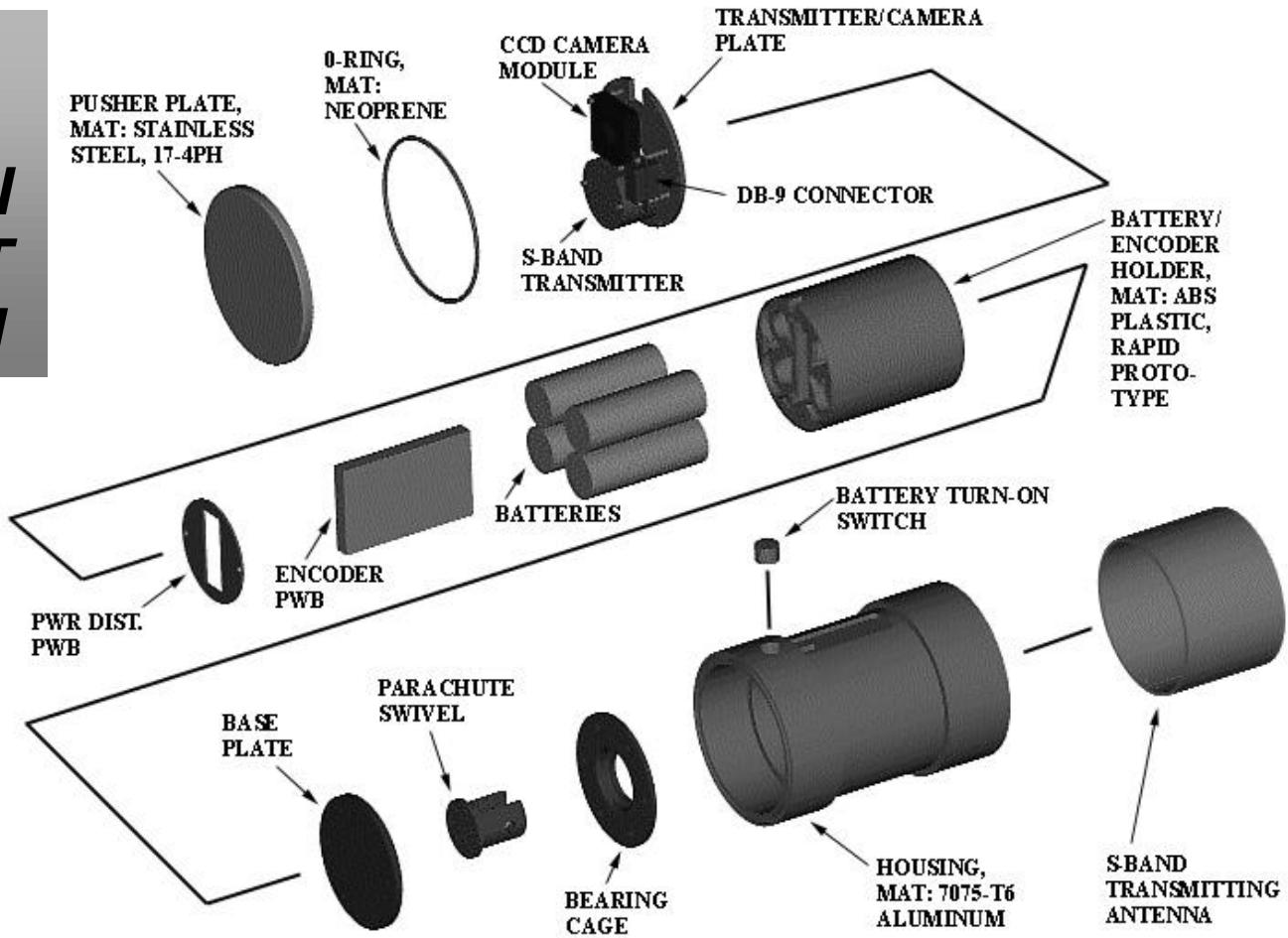
FLIGHT TEST PLATFORM – REQ.'D MODS.



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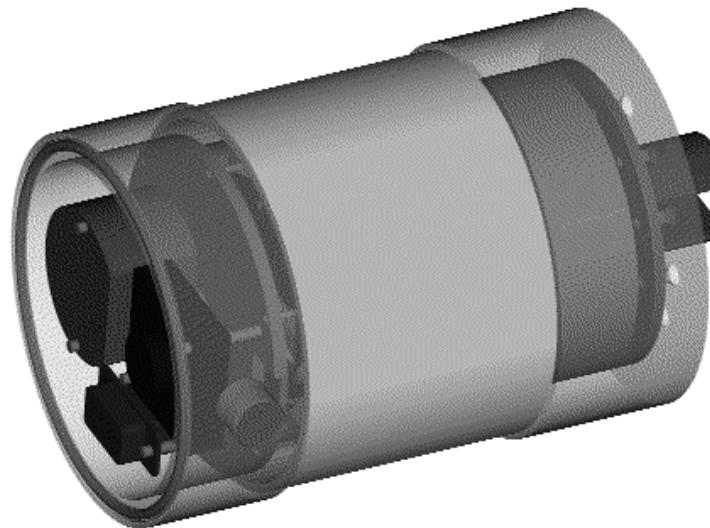
IMAGER SUB- MUNITION CONCEPT & DESIGN



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<u>IMAGER BOM (NON-PROD. VERSION)</u>	\$
COTS CCD CAMERA	120
COTS VIDEO COMPRESSION ENCODER	2880
COTS XMTR, S-BAND, HI-G Q'D.	4000
COTS ANTENNA, S-BAND	1525
<u>COTS BATTERIES, NICAD</u>	<u>50</u>
<i>PER UNIT COST (W/O NRE & LABOR COSTS)</i>	<i>8575</i>



Design & Flight Testing of a Mortar Deployed Video Imager

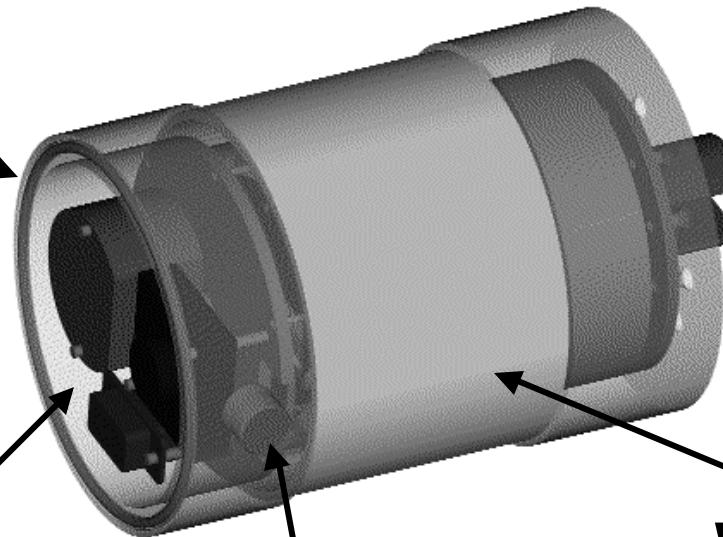
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KEY DESIGN FEATURES....

O-RING SEAL
FOR INTERNAL
EXPULSION GAS
RESISTANCE

IMAGER
FOV

ENCAPSULATE
INTERIOR VOL.
& COMPS. TO
SHOCK-HARDEN



INTERFACE
TO EXISTING
PARACHUTE

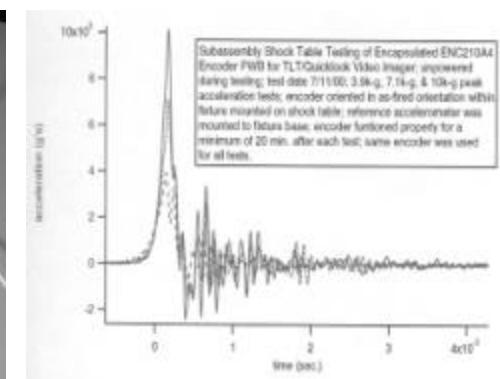
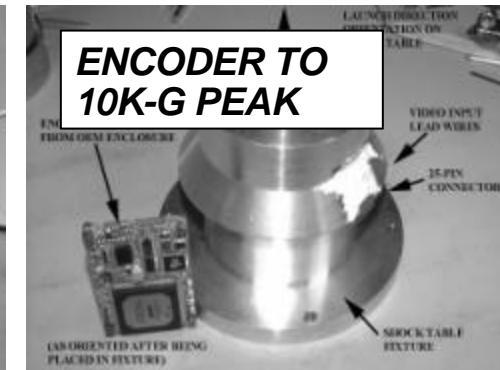
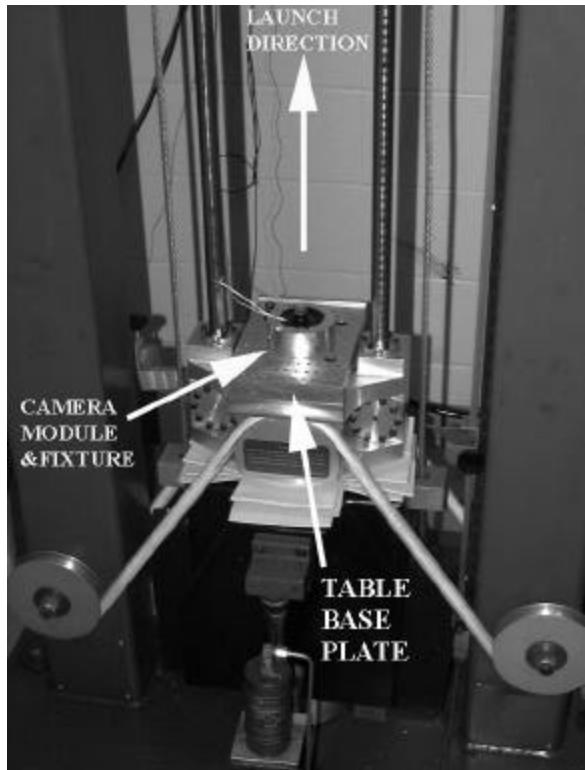
INTEGRATE
WRAP-AROUND
ANTENNA

THRU-MORTAR-BODY
MAN. TURN-ON
SWITCH

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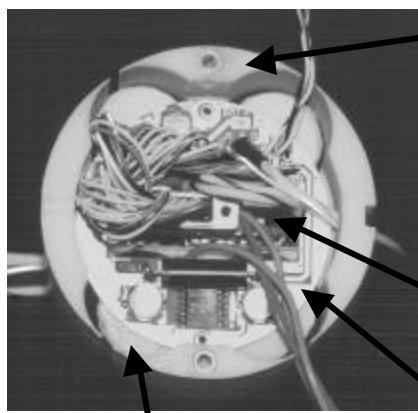
GROUND SHOCK TABLE TESTING OF IMAGER COMPONENTS...



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ASSEMBLE....



**ABS PLASTIC RP
BATT+ENCD'R+
PWR BOARD
HOLDER
(used CAE art-to-
part technologies,
FDM)**

**ENCD'R BRD
(OEM as is)**

PWR BRD

**4X NICAD BATTs,
(20min. total discharge time)**



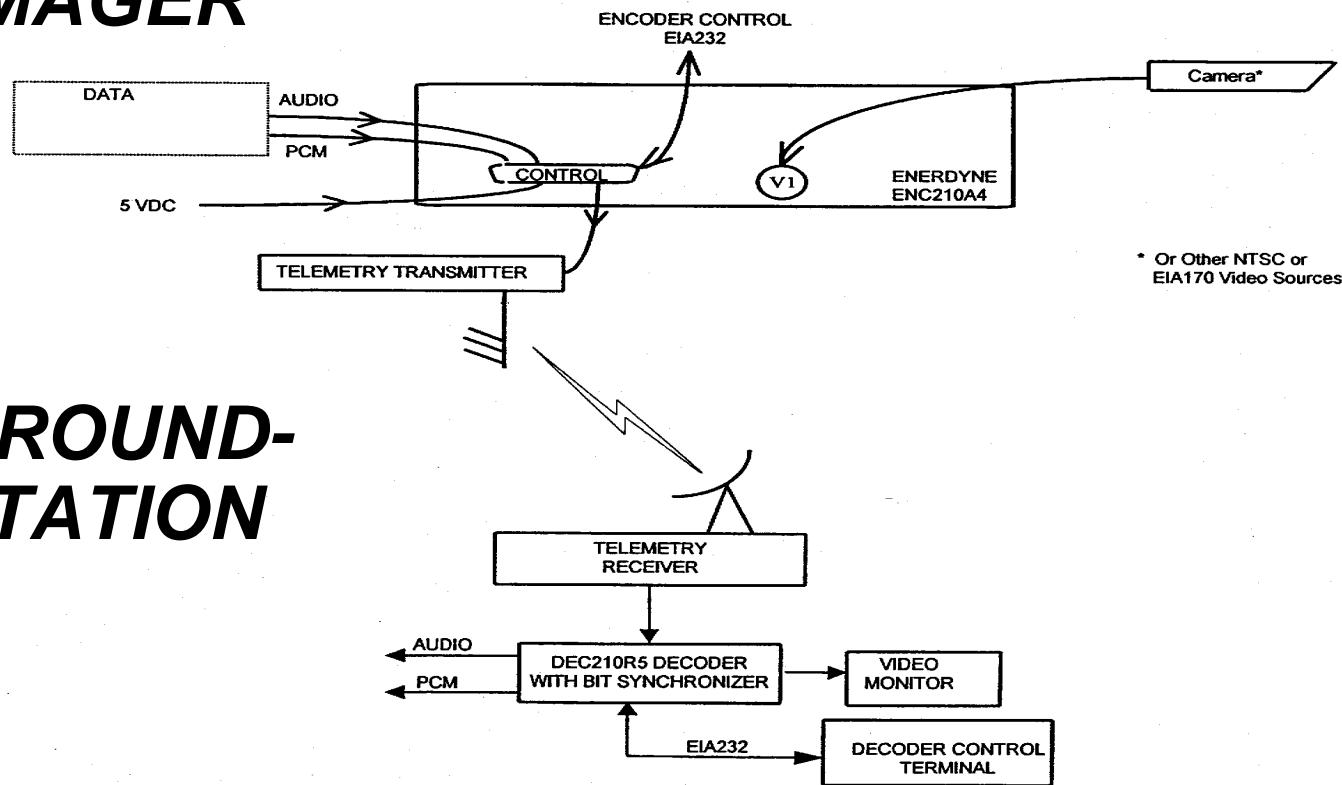
ENCAPSULATE....

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IMAGER SYSTEM

IMAGER

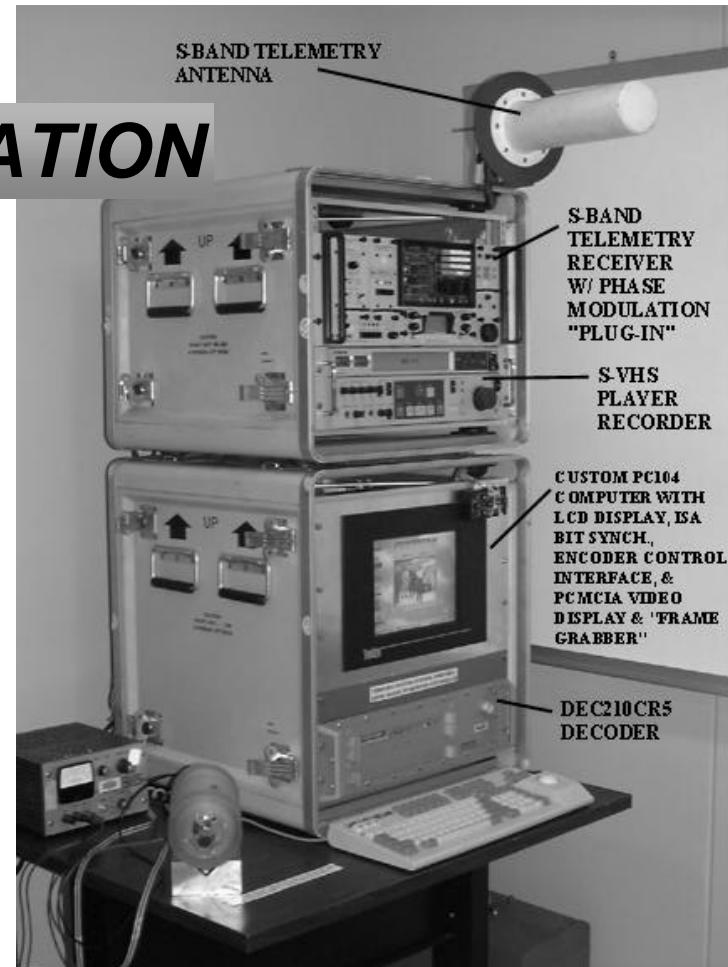


GROUND- STATION

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IMAGER GROUND STATION

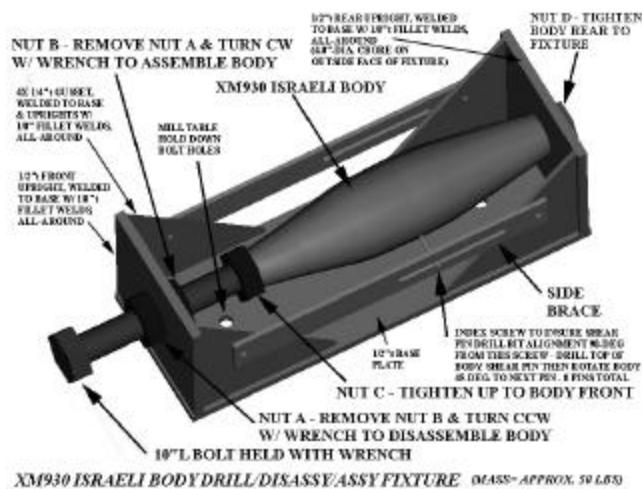


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DESIGNED & BUILT A LOW-COST, IN-LAB MORTAR BODY ASSEMBLY FIXTURE

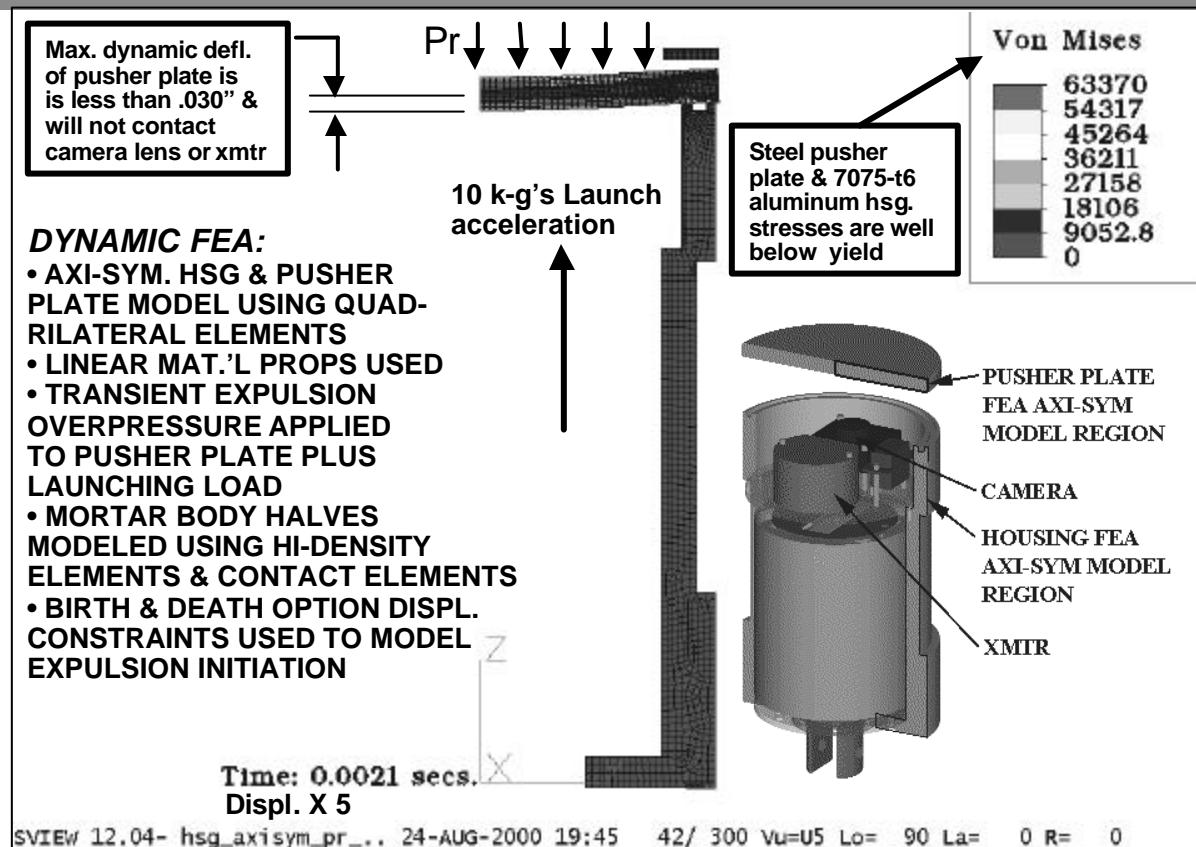
- FOR BATTERY TURN-ON SW. PORT INSTALL.
- IMAGER INSTALLATION
- MORTAR BODY SHEAR PIN INSERTION



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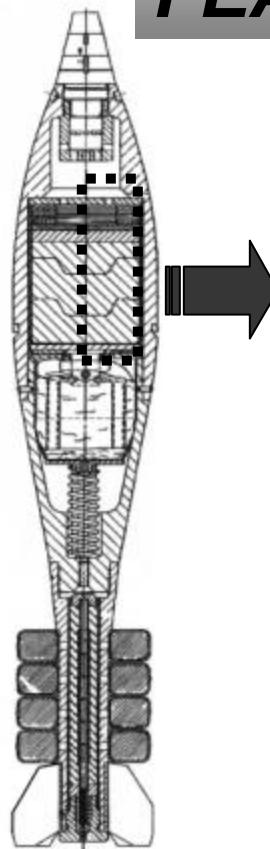
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VERIFIED HSG. & PLATE STRUCTURAL INTEGRITY AND MORTAR EXPULSION DYNAMICS WITH FEA



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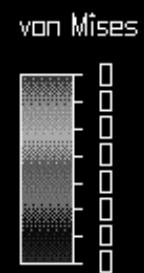
FEA ANIMATION...EXPULSION

Structural Dynamic FEA of Axi-Sym. Imager Hsg. & Pusher Plate

Time: 0 secs.

Expulsion Pressure Load Case

Displacements X1



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FLIGHT TESTED MOCKUP IMAGER ROUNDS

- INSURED EXPULSION & CHUTE DEPLOYMENT
- VERIFIED INTEGRITY OF HOUSING & FEA PREDICTIONS
- VERIFIED INTEGRITY ANTENNA
- VERIFIED O-RING SEAL
- VERIFIED PUSHER PLATE DYNAMICS



**120mm MORTARS... WARMERS
& MOCKUP IMAGER ROUND**

**RECOVERED MORTAR BODY HALVES
AND MOCKUP IMAGER**



RECOVERED MOCKUP IMAGER



MINIMAL RESIDUE DEPOSITED BY EXPUL. CHARGE GAS BLOW-BY... CAMERA LENS SHOULD BE O.K.

CONTACT PINS WERE NOT CONTACTED BY PUSHER PLATE DURING EXPULSION... CAMERA & XMTR SHOULD BE O.K.

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FLIGHT TESTING OF IMAGER MORTAR ROUND

- PROVED IMAGER ROBUSTNESS TO TYPICAL MORTAR GUN-LAUNCHING LOADS (1500-3000 g's)...MINOR ANTENNA DAMAGE SUSTAINED IN SHOT
- IMAGER RECOVERED AND WAS REUSEABLE
- 5 FR/SEC (@1.25MBITS/SEC.) ACQUIRED FOR 90 SEC. DECENT FROM EXPULSION @ 1400' ALTITUDE; INITIAL CAMERA FOV @ EXPULSION = 1616' x 1553', i.e. ~ 1m x 1m = 1 pixel

20sec. of video from imager



*20sec. of video of decending
imager from camcorder on
ground*

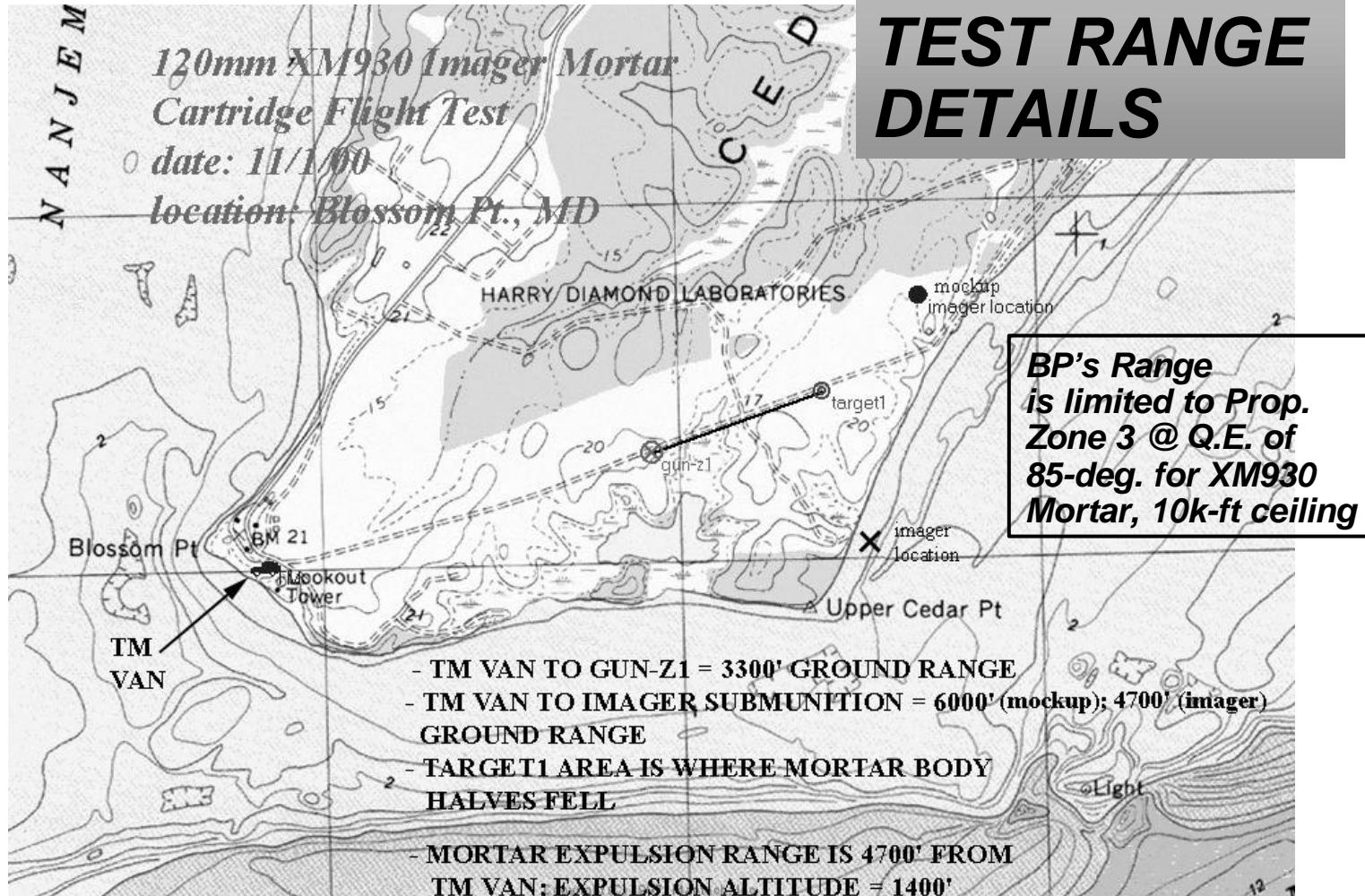




Weapons and Materials
Research Directorate

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SUMMARY

- ***120mm MORTAR IMAGER CONCEPT PROVEN***
- ***IMAGER GUN-HARDENED TO ~2000 gs***
- ***IMAGER LESSONS LEARNED & FUTURE...***
 - ***IMAGE QUALITY & USE MUST BE ADDRESSED***
 - ***ANTENNA RECEPTION ISSUES [VIDEO DROP-OUTS] MUST BE ADDRESSED***
 - ***INTEGRATE NEW HSTSS XMTR, INERTIAL SENSORS, SIG. COND., ADDITIONAL PCM ENCODER, NEW BATTERY, & GPS REC'R...SENSORS TELL WHERE IMAGER IS LOOKING***
 - ***ADDITION OF INTERNAL G-SWITCH TURN-ON FEATURE; REDUCES BATTERY VOL., ELIMINATES GUNNER TASK.***